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NOTICES OF NEW BOOKS.

Our Notions of Number and Space. By HERBERT NICHOLS, Ph.D. Boston, Ginn & Co., 1894.—pp. vi, 201.

The author, well known by his book on the Psychology of Time, has expounded in the work before us his views on the formation of the spatial order in our tactual sensations. He who, in reading the title of this new book, is disposed to expect the exposition of a theory of Space, based on Mathematics and Theory of Knowledge, will be disappointed, for the work is in the first place experimental, although the author thought it proper to conclude with a summary of 109 propositions, called laws, in which he combines the results of his experimental research with the demands of a theoretically developed hypothesis. The experiments are in a certain way a model of exact and careful work, carried out with the simplest means, but with so many variations of these that scarcely any factor influencing tactual space-perception is neglected. The results are, in spite of the careful arrangement of the tables in which they are presented, not easy to review.

In the first series of experiments 5 (or 9) categories of distance, ranging from 1 to 5 cm., are represented by 2, 3, 4, and 5-equally distributed pins, which are applied to the surface of the tongue, forehead, forearm, and abdomen. With each distance- and each number-category there are performed 100 trials on each of four persons. The tables contain, besides the average percentage of correct judgments, the percentage and direction of error which has been made, but it is not clear from the tables how this error was calculated. One would expect that the accuracy of number-judgment increases with the distance, but this has been found true only for smaller numbers of pins. With regard to higher numbers the somewhat surprising result is reached, that the accuracy decreases when the distance increases. In other words, the accuracy of number-judgment has its maximum with small numbers distributed over a large space, and with great numbers confined to a small space. For the estimation of distances the results are very similar. In this first series the pins were always arranged in a straight line. In a second experiment they formed geometrical figures, triangles and squares: in some of them the pins represented only the corners; in others the sides were bisected or the middle point of the whole figure was indicated by a pin. The chief result of this second experiment was, that the judgments of number and distance are more accurate when the stimuli have a two-dimensional arrangement than when arranged in a straight line.

The important part which the two-dimensional arrangement plays, is demonstrated in a special experiment, where the attention was given only to the number of points sensed. This exclusion of the factor of shape, although it could only be approximately reached, had the effect that only for small numbers of pins, arranged in a square or triangle and at not too small a distance, the judgment was sometimes correct (20 for triangles, 30 for squares formed the highest percentage), whilst for higher numbers no correct judgment occurred. The recognition of the figure, which for the tongue never failed, went in none of all these experiments below a percentage of 90, and seemed to be little or not at all influenced by the pins which bisected the sides or indicated the middle.

A special experiment, where the method of "rocking the pins back and forth," which in all other experiments was permitted to the subject, was abandoned, and stimulation was made by "pressing evenly three times only," shows always a greatly diminished accuracy of judgment. Two further series were taken with lineal and solid figures. In distance and figure judgment, squares show throughout an increasing accuracy with the increasing size of the figure, whilst for triangles and circles the direction of the variation changes. For small surfaces the order of accuracy is mainly as follows: triangles, circles, squares; for great surfaces: squares, circles, triangles. In his remarks on the advantage which one of these figures may have over the other, the author has neglected a point which seems to me to be of some importance. Circles and squares are circular-symmetrical figures which are divided into two parts, equal in surface and shape, by every straight line going through the center. This is the case for equilateral triangles only in a few special instances. In all cases where the direction of movements (or movement tendencies) plays a part, the squares and circles, by the equal distribution of their outlines and surface on both sides of the direction of the movement, will have a certain advantage over the triangles, which may compensate for the advantage which triangles have on account of the smaller number and greater acuteness of their angles. This factor may account perhaps for the differences found in the figure-estimation, according as the figure was rocked or pressed evenly.

In a further series of experiments the author by introducing motion tries to separate the influence of such factors as 'mass' (both of stimuli and feelings), 'intensity' (both peripheral and central), and 'time-rate' (both of stimulation and mental response). These experiments were performed with an ivory pencil moved over the skin with varying pressure and speed. In the tables thus obtained for the four combinations, "quick and light, quick and heavy, slow and light, slow and heavy," the greatest average accuracy is shown in the case of quick and heavy movements. Besides this there seems to be for light movements (quick as well as slow) a marked tendency to under-estimation, whilst in almost all other cases the error turned out positive. The last series had as its object the comparison of horizontal and vertical distances. The method of this experiment and the arrangement of the tables are rather peculiar and in some respects objectionable, especially with reference to the circumstance that the greater distance has always been applied vertically. The same must be said of the omission of those judgments where the difference of 1 mm. was not perceived. This omission is here just as objectionable as the elimination of the doubtful judgments in the method of right and wrong cases.

The author deduces from these experiments three laws. The first is a law of chance based on the fact that the knowledge about the categories used does not allow over-estimation of the greatest nor under-estimation of the least distance- and number-magnitudes which were applied. The second law may be stated as follows: The longer the distance, the more accurate the number- and distance-judgment. The exceptions to this law, found in the experiments with higher number-categories, are caused by a third law, which reads as follows: "The lower the numerical category the stronger is the tendency of the uncertain judgment to drift toward over-estimation." The theory which the author advocates is that of the reduction of the spatial order to Succession in Time. No spatial presentation would arise if there were not a previous successive stimulation of the dermal areas concerned. Spatial order is entirely based on serial presentations in time. If the original series are continuous, the spatial presentation will be a line; if the terms of the original series are sufficiently broken, the spatial presentation will be a numerical one. Law 17 says: "A distance-presentation or the apparent length of a line will express the average length of all the time series, in which the peripheral line has through life been stimulated." It may perhaps be well to quote here the proposition in which the author summarizes his thesis at the end of his book. "Presentations of Number, of Distance, and all Spatial Figures and arrangements in general, are alike based, primarily, upon serial events differing greatly in mode, such as become characteristic of those modes of presentation which we call numerical, extential and spatial, but all of them governed by the same fundamental laws of relationship. By reason of this, all simultaneous presentations are dependent upon, and expressive of, the several modes of serial occurrence out of which, through life, they have evolved, and become differentiated."

There remain to be mentioned two experiments by which the author tries to test his theory. The first one consisted in the application of a single pin but without the subject's knowledge of its singleness. It was found that the subject had always the impression of a pair of pins at a definite distance from each other. This shows clearly the great influence which central processes exert on the judgment of number and distance. But it seems to me also to demonstrate that the method of all these experiments would have been more adequate to the problem to be solved, if the single pin (and also higher number- and distance-categories than those actually investigated) had been used throughout; the complication through the laws of chance and of the drift of errors would thus have been avoided. In the second experiment, performed with an ingeniously devised apparatus with a decoy-pin, the author aims at testing the validity of his hypothesis by changing the coördination of skin-areas through continuous training, but with the exclusion of every control by other spatial presentations. The preliminary report of the results is favorable to the hypothesis.

A few critical remarks of a general character may be added. There are two standpoints, from which the problems of space-presentation may be viewed. There is first the narrower problem of Experimental Psychology: How do we arrive at the univocal and uncontradicted order of our presentations in space (space taken as immediately given, or as the result of a mutual coöperation of all senses)? There is secondly the wider problem of Theory of Knowledge: Is space immediately given, or can it be derived from something else? In reading the theoretical discussions of the author and the laws he establishes, one must come to the conclusion that he neither realizes the full significance of the second problem, nor aims at a proper solution of the same. Whoever intends to derive space from something else, from time-succession, for instance, must not start with "different parts of the skin," with "combinations of peripheral nerves," with "brain-habits" and "average tendencies." The simple assumption that "dermal presentations are chiefly founded upon terms alike in kind but differing in intensity," does not solve the problem, but confines it only to narrower limits. For, if this proposition is correct, why are some successive series of intensities brought into spatial order, and others not? It must be shown, how from *non-spatial* properties, as intensity, quality, and time relation of sensations, spatial presentation may arise. That is what the author has not done. He does not derive our notions of number and space "from purely successive series," but he derives number-, distance-, and figure-estimation from the successive stimulation of — spatially different parts of the skin. Therefore we may say that the work contributes nothing to the solution of the general problem of space, but it is an extremely valuable contribution to our knowledge of the spatial order of dermal presentations.

A. KIRSCHMANN.

John Stuart Mill; a Study of his Philosophy. By CHARLES DOUGLAS, M.A., D.SC., Lecturer in Moral Philosophy in the University of Edinburgh. Edinburgh and London, Blackwood & Sons, 1895. — pp. xv, 274.

"We hear nothing of Mill now," a veteran teacher remarked recently to the writer, "and a little while ago he was the center of power and interest." A new logic and a new psychology have asserted their claims victoriously; a new political economy and a new ethics are in the field. Eighteenth-century individualism and sensationalism, which lived on into this century, have given ground to idealism and an organic conception. Mill seemed to himself and to his contemporaries to be the champion of 'experience,' with all that the word implied for the successor of Hume and James Mill and Bentham. The inconsistencies of his logic, psychology, and ethics have been often criticized, but in the book before us, Dr. Douglas has traced the twofold Mill with rare sympathy and thoroughness. He shows how Mill's inheritance of individualism, which appears as sensationalism in the theory of knowledge and as egoism in that of conduct, is profoundly modified by